



NATIONAL INSTITUTE FOR ROCKET PROPULSION SYSTEMS

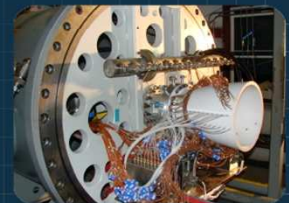
NIRPS: An Update

Space Transportation Association

July 9, 2013

Dale Thomas, Ph.D, P.E.

Associate Director, Technical
Marshall Space Flight Center



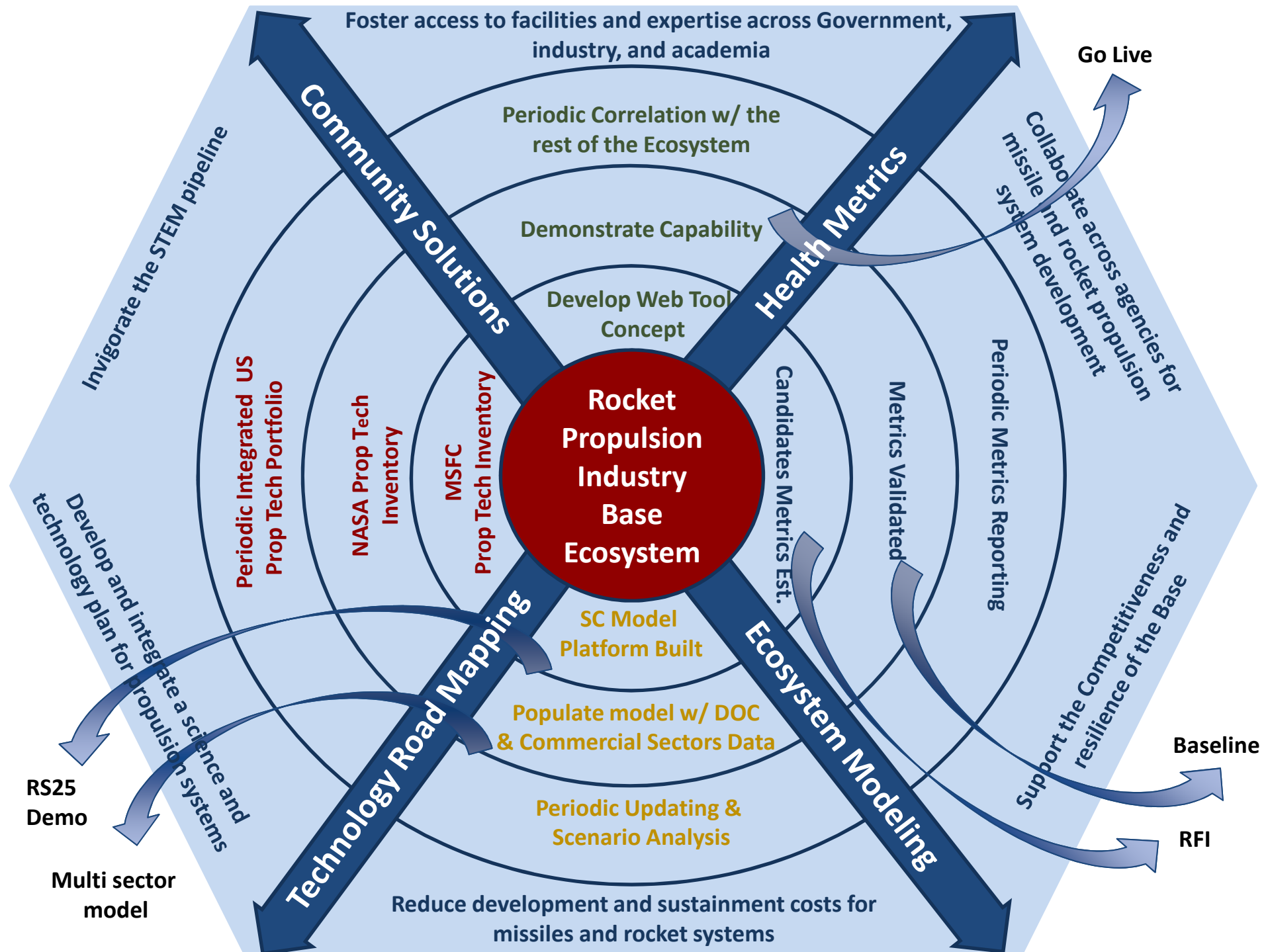
NIRPS: Where we started

- Widespread recognition of the problem
- September 16, 2011 NIRPS authorization letter signed by NASA Administrator Bolden
- Established MSFC as NASA lead, in cooperation with USAF, NRO
- Briefed Space Transportation Association on October 12, 2011 re. needs, policy guidance, & plans



Derivation of the Grand Challenges





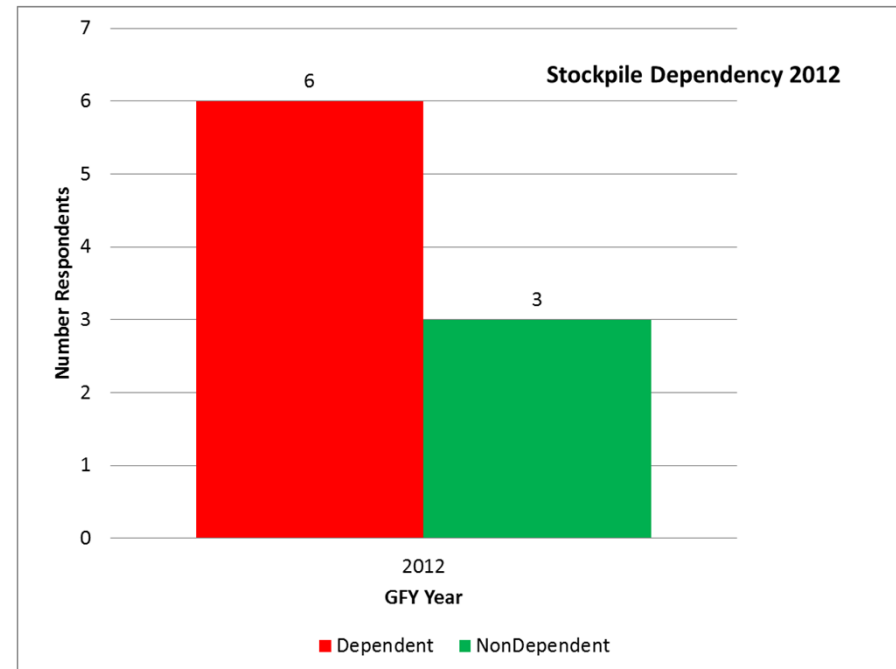
Accomplishments Addressing the Grand Challenges

Support competitiveness of IB	Invigorate STEM Pipeline	Develop integrated S&T plan	Reduce development and sustainment costs	Collaborate across agencies	Foster access across IB
<ul style="list-style-type: none"> • Analyzing data from industry and government to develop a snapshot of U.S. rocket propulsion industrial base health • Developing supply chain analysis methods to support SLS architecture decisions and determine effects of decisions on industrial base 	<ul style="list-style-type: none"> • Supported continued development and university utilization of the MSFC Generalized Fluid System Simulation Program (GFSSP) • Planning academic workshop to solicit inputs from academic community on NIRPS activities and strategic plan 	<ul style="list-style-type: none"> • Leading inter-agency task team responding to NDAA 2011 Sec. 1095 action to develop national rocket propulsion strategy • NIRPS and AFRL working to integrate NASA roadmaps with IHP RPT roadmaps 	<ul style="list-style-type: none"> • Supported NASA/DoD ammonium perchlorate collaborative procurement • Hot-fire testing of 3-D printed SLM engine injector 	<ul style="list-style-type: none"> • Acquired CPIAC Support for Skills & Capabilities directory/web tool • Supported negotiations with USAF on AUSEP & AKE collaboration • Performed additional study requested by OSTP on national altitude test capability • Cross-community skills, capabilities, and subject matter expert directory, and web tool demonstrated 	<ul style="list-style-type: none"> • Developing strategies for easier access to US government facilities & expertise in partnership with Defense Acquisition University

Support Competitiveness of Industrial Base

Industrial Base Health Metrics

- **Objective:** develop useful metrics that can serve as indicators of the the overall health of the Propulsion Industrial Base
- **Developed** survey to collect data for Industrial Base Health Metrics
- **Input** from a variety of organizations
- **Analyze** data for publication as an AIAA paper, Fall 2013
- **Compare** with Department of Commerce data for validation



Support Competitiveness of Industrial Base

SLS Supply Chain Analysis

- Objective: Inform Agency Decision makers of the impacts to the Propulsion Industrial Base, due to potential SLS architecture decisions
- NIRPS and Aerospace Corporation to execute in conjunction with HEOMD, SLS (Engines and Booster Offices)
- USAF PEO M&S and USN SSP insight/review
- Primary Tasks initiated and additional phases planned
- Additional Phases will study liquids/solids and tactical/strategic applications
- Current Status



Invigorate STEM Pipeline

Academic Workshop

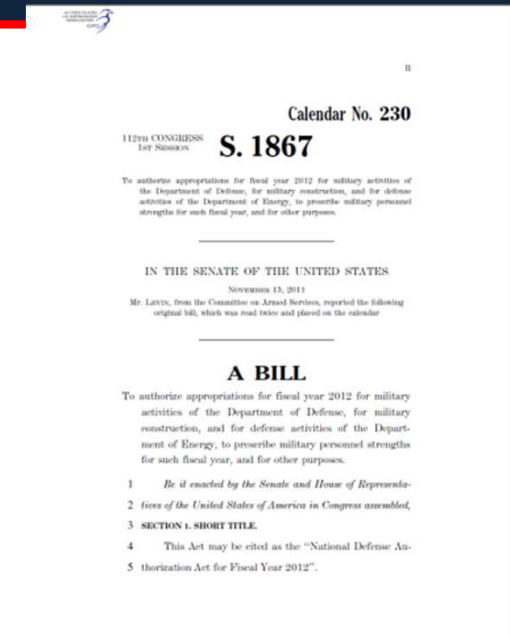
- Objective: to provide a forum to solicit input from the academic community on NIRPS
- Location: UA Huntsville
- Date: fall 2013
- Membership: UA Huntsville will coordinate membership. Dr. Bob Fredrick and Dr. Tom Koshut will lead effort



National Rocket Propulsion Strategy

NDAA Sec. 1095

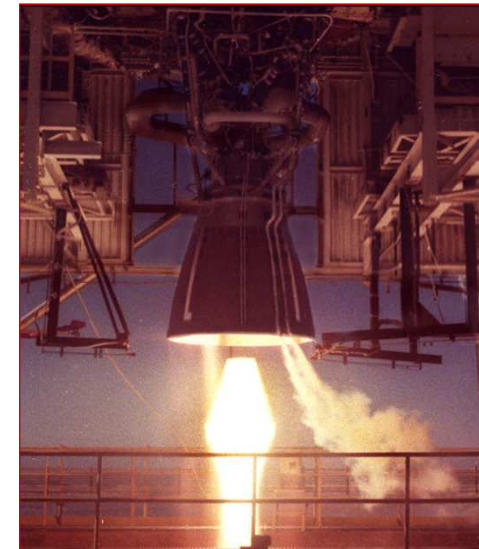
- *Sustainment of rocket propulsion base is “a national challenge”*
- *Requires President provide a national rocket propulsion strategy including:*
 - *Effect on industrial base of Space Shuttle closeout and Constellation termination*
 - *Administration plans to mitigate impacts to industrial base*
 - *Consolidated plan w/ key decision points for current and next-generation requirements*
 - *Options/recommendations for synchronizing plans, programs, budgets for R&D, procurement, operations and workforce among federal agencies to strengthen industrial base*
- **Interagency Task Team formed w/ equity holders from USG including NASA, DoD, NRO, and FAA**
- **Senior Steering Group (SSG) has held seven meetings with Inter Agency Task Team to provide guidance to the team**
- **Delivery of final report to OSTP completed January 2013**
- **OSTP developed draft National Rocket Propulsion Strategy in May 2013 – in review and coordination cycle with Agencies**



Develop Integrated S&T Plan

Integrated High Payoff Rocket Propulsion Technology (IHPRPT) Steering Committee Meeting April 23-24 at Edwards AFB

- Interest in MSFC Additive Manufacturing, Structured Light technology
- MSFC supporting AF Risk Reduction re. Hydrocarbon Boost Demo
- AF interest in F-1 GG testing
- AF Solid Rocket Modeling tool development useful to MSFC analysts
- AFRL Plasma Modeling of interest to MSFC Electric Propulsion group
- AF Solid Propulsion Aging and Surveillance work applicable to NASA SRB work and composite case and CIF work on electrically controlled solids
- Several informal MSFC/AFRL discussions re. collaboration
- Planning meeting to discuss mapping NASA and IHPRPT Roadmaps
- Inputting NASA technology to IHPRPT GOTChA process



Reduce Development, Sustainment Costs

Coordinated AP Buy

- **Ammonium perchlorate (AP)** used by every armed service and many commercial firms
- **Historical decline** in demand for ammonium perchlorate, increasing costs and threatening remaining domestic supplier
- **NIRPS facilitated** coordination between government users in early 2012, stabilizing demand, production, and pricing.

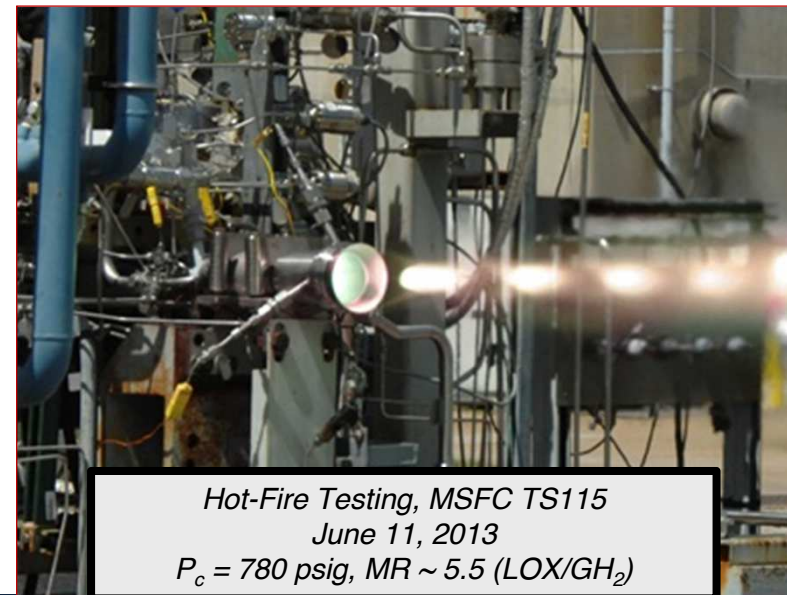


- **NIRPS AP Team presented** Technical Achievement Award from the Air, Space and Missile Defense Association Jan. 25, 2012

Reduce Development, Sustainment Costs

One-Piece SLM Injector Design, Fabrication, & Hot-Fire Testing Performed In-house at NASA-MSFC

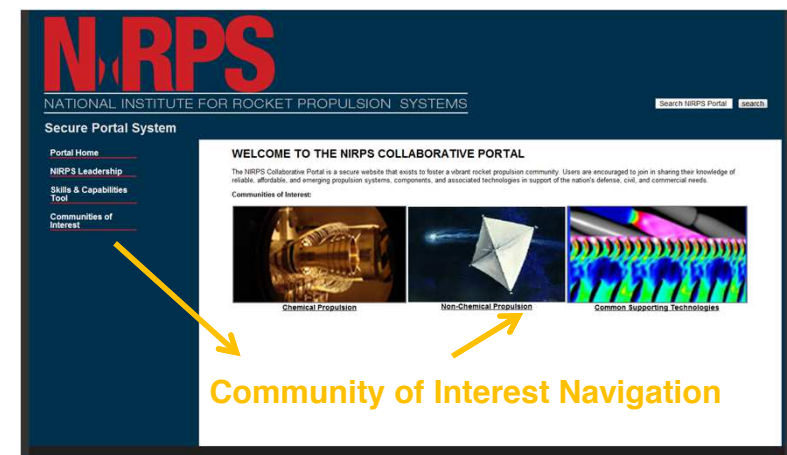
- Traditional injector : 4 parts, 5 welds, 6 months
- SLM injector: 1 piece, 3 weeks printer to test stand
- Post-test inspections indicated that the injectors remained in excellent condition



Hot-Fire Testing, MSFC TS115
June 11, 2013
 $P_c = 780$ psig, MR ~ 5.5 (LOX/GH₂)

Foster Access Across IB

- Developed key “solutions strategies”
- Contracted tasks with CPIAC to continue additional development of NIRPS Web Capability
- Initiated task with Defense Acquisition University to perform streamlined facilitation mechanisms study
- Upcoming Schedule - NIRPS Skills & Capabilities Directory/Web Portal
 - July 2013 Skill & Capabilities Directory “Goes Live”
 - Sept 2013 Implement Small Team Collaboration Sites
 - Dec 2013 Implement Communities of Interest Sites
 - Dec 2013 Release Fully Functional Web Portal Tool



NIRPS FY13 Goals

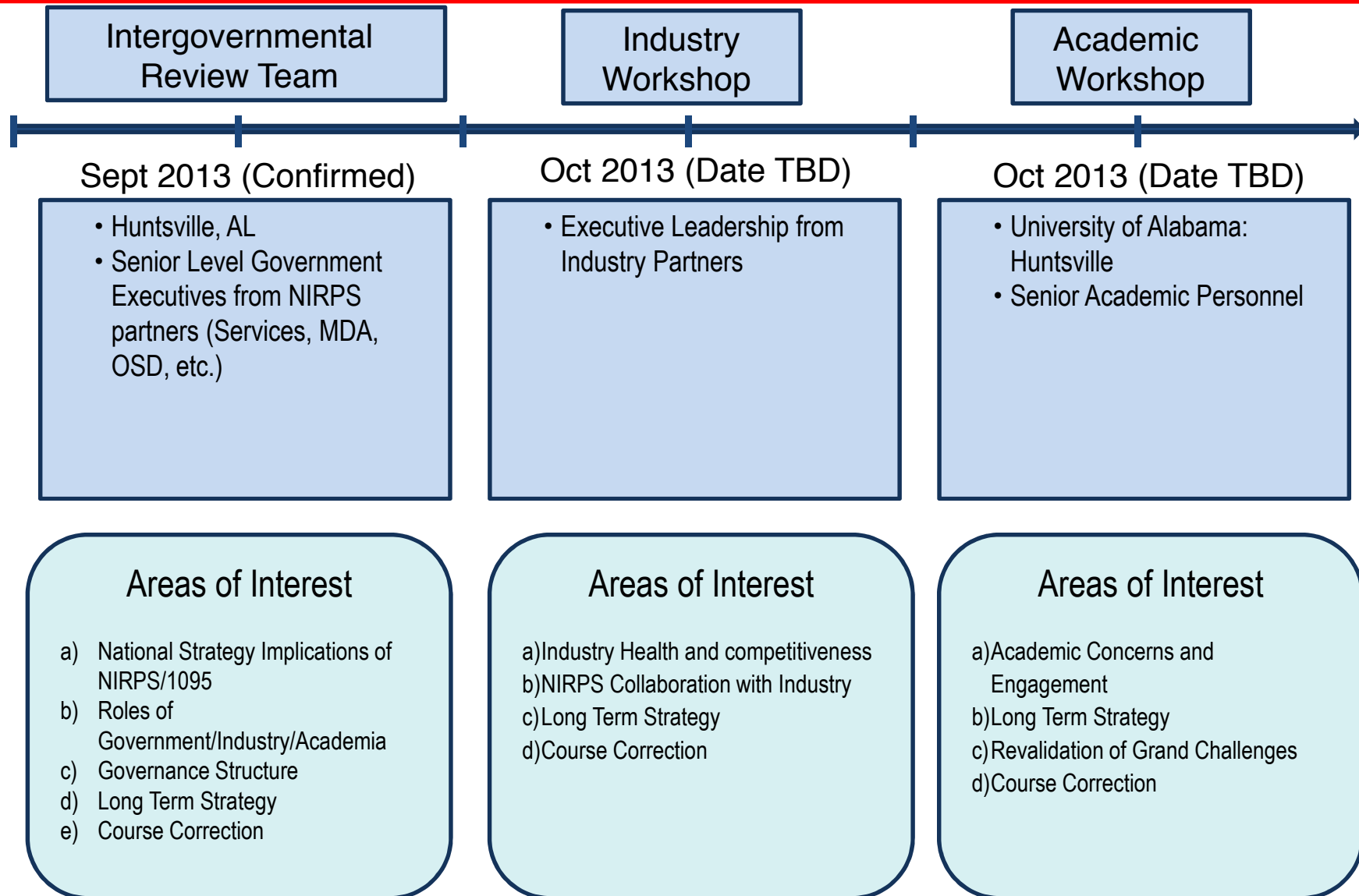
Grand Challenges	FY13 Goals	Team	Status
1. Support the Competitiveness and resilience of the industrial Base	1.1 Develop Supply Chain Analysis for SLS Architecture Decisions.	Stewardship	
	1.2 Develop Metrics to Determine Health of Industrial Base.	Stewardship	
2. Invigorate the STEM pipeline	2.1 Provide engineering students with practical experience utilizing propulsion design and analysis tools and methodologies.	Solutions Facilitator	
3. Develop and integrate a science and technology plan for propulsion systems	3.1 Use existing roadmaps to identify opportunities for collaborations and leveraging of complimentary activities.	Technology	
4. Reduce development and sustainment costs for missiles and rocket systems	4.1 Conduct a study/survey of low cost technology test beds and/or other methods for transitioning propulsion component /sub-system technologies through the TRL valley of death (TRL 4-6).	Technology	
5. Collaborate across agencies for missile and rocket propulsion system development	5.1 Develop initial community of interest capability.	Solutions Facilitator	
	5.2 Establish a Cross-Cutting Collaborative Solutions Team that executes tasks of cross community interest, stimulating potential follow-on collaborations.	Solutions Facilitator	
6. Foster access to facilities and expertise across Government, industry, and academia	6.1 Develop initial Propulsion Skills and Capabilities Directory & Web Tool.	Solutions Facilitator	
	6.2 Complete study of mechanisms for potential pass through process to ease access to cross government skills and capabilities.	Solutions Facilitator	
Integrated Goals			
Integrated Goals	IG.1 Develop operational model defining management concepts, operating principles and framework, and high-level goals including a concept of management oversight for periodic evaluation.	Integrated	
	IG.2 Develop a comprehensive Strategic Communications Plan that addresses external and internal stakeholders, interactive websites, and outreach planning for public, STEM, and Agency/Industry engagement.	Integrated	
	IG.3 Establish a National Charter.	Integrated	
	IG.4 NDAA 1095 Follow-on Activity.	Integrated	

Have not started

On Plan

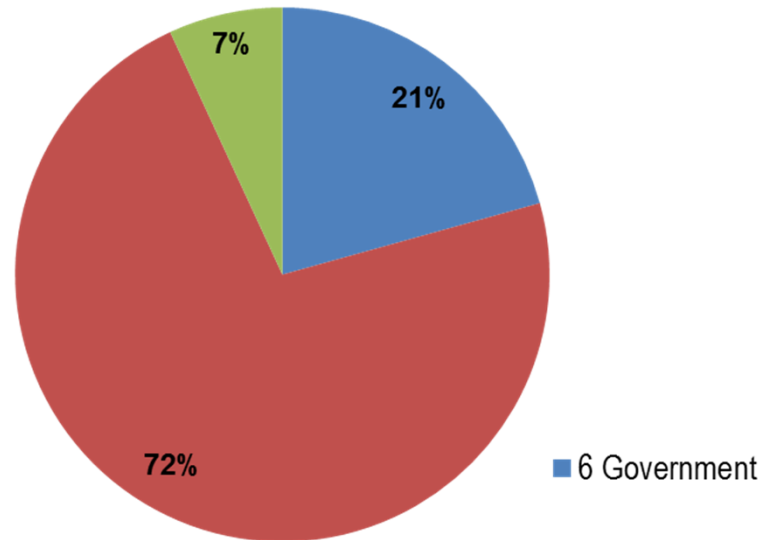
Known Issues

Looking Ahead: Reviews and Workshops



Growing Participation

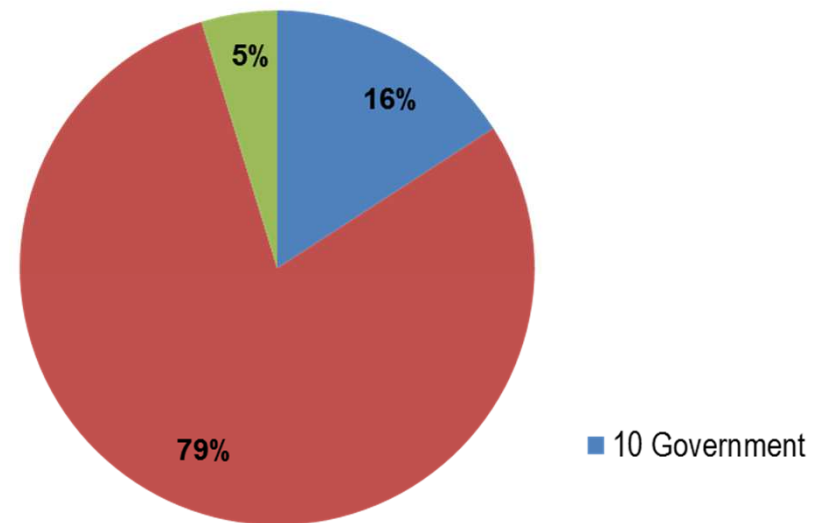
November 2011



**80 Individuals
29 Organizations Represented**

■ 6 Government
■ 21 Industry
■ 2 Academic

June 24, 2013

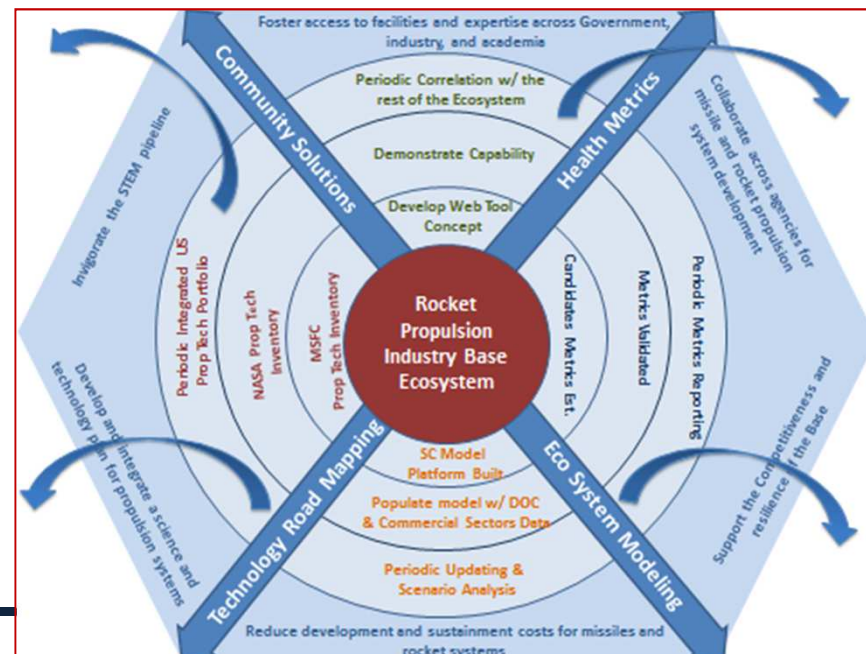


**201 Individuals
63 Organizations Represented**

■ 10 Government
■ 50 Industry
■ 3 Academic

Looking Forward: Challenges, Opportunities

- FY 2013 is a year of consolidation and execution
 - Pivot from organizational formulation to adding real value to the Propulsion Community
- FY2014 will be a year of continued execution and establishment of pedigree
 - Official Charter and Inter-Agency Memoranda of Understanding
 - Continued performance of tasks addressing the Grand Challenges



Summary

NIRPS

National Institute for
Rocket Propulsion Systems

<http://nirps.msfc.nasa.gov/home>